

PRESENT STATUS OF THE ESTUARINE FLORA OF THE GODAVARI AND THE KRISHNA¹

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(With two text-figures)

While working for the district flora projects (1980-86), the author surveyed extensively the mangrove forests of the Godavari and the Krishna estuaries and collected a good number of mangroves and their associates. The total collections represent 45 species of 37 genera belonging to 26 families (45/37/26). Among them 15/10/8 are true mangroves, 18/18/13 mangrove associates, 10/8/6 halophytes and 2/1/1 sea grasses. The survey resulted in the identification of *Scyphiphora hydrophyllacea* Gaertn. f. (Rubiaceae), a rare mangrove species for the Indian mainland. One very interesting observation is *Prosopis chilensis* (Molina) Stuntz growing in association with *Sonneratia*, *Acanthus* etc.

INTRODUCTION

Mangrove forests are dominant intertidal communities well adapted to colonise the regions where other species are unable to grow. The mangrove zones are highly productive ecosystems which help in carbon, nitrogen and sulphur recycling in nature, besides acting as nurseries for juvenile fish population and providing fire-wood, construction materials and minor timber for fishing boats etc.

Excellent mangrove forests in the Godavari estuary with dense growth of *Avicennia* spp. mixed with other associates of the mangrove zone were recorded during the early part of this century. They cannot be seen anywhere now due to over exploitation by way of fuel auctions by the State Forest Department and other agencies since 1920. Such exploitation was done without understanding the need for special mangrove forest management, which is completely different from the routine forest management of the deciduous forests of India (Rao 1959). Now the extensive mud-flats are over-exposed and heavily mixed with sand, thus becoming unsuitable for the natural regeneration of mangrove species along the two river mouths, besides disturbing the growth and development of fish and other marine species. Poor quality rice cultivation and coconut plantation have been penetrating year after year, together with cutting down of whatever mangrove tree species are available for fuel purposes. Projecting sand creeks with good growth of *Pandanus*, forming closely knitted, extremely

strong fortwall-like protective barricades are also being disturbed wherever man has entered with his cultivation. This resulted in the high cyclonic waves which in 1977 devastated the entire False Divi area (Fig. 1) with heavy loss of life and property along the Krishna estuary (Venkanna 1988).

STUDY AREA

These estuarine zones lie between 15° 43' to 16° 50' N and 80° 45' to 82° 20' E and occupy an area of about 480.84 sq. km (Table 1).

Soils: The soil is entirely river borne alluvial silt and extremely fine mud, forming extensive muddy flats. In certain parts it is mixed with overlying sand, either blown by wind or deposited by waves.

Climate: The regional bioclimate belongs to tropical humid type with a dry season of 5 to 6 months (December to May). The rainfall reaches a maximum in October, due to violent cyclones, which frequently hit the east coast of India, bringing torrential rains exceeding 200 mm in a few hours. The average rainfall is about 1000 mm/year. The mean annual temperatures during the hottest and coldest months are 28°C and 19°C respectively. Salinity levels of more than 40‰ seen in the mangrove waters between May and July, fall to 5‰ between October and December.

Earlier literature: The works of Roxburgh (1795-1819), Hooker (1872-1897) and Gamble (1915-1936) are the most important amongst the few which dealt with the coastal plants of the area. Later Venkateswarlu (1944, 1946), Rao (1959), Wagh (1960), Sidhu (1963), Raju (1968), Rao and Sastry (1972, 1974), Sastry and Rao (1973), Blasco (1975), Chapman (1976), Rao *et al.* (1985, 1986) and Venkanna (1988) have given a comprehensive ac-

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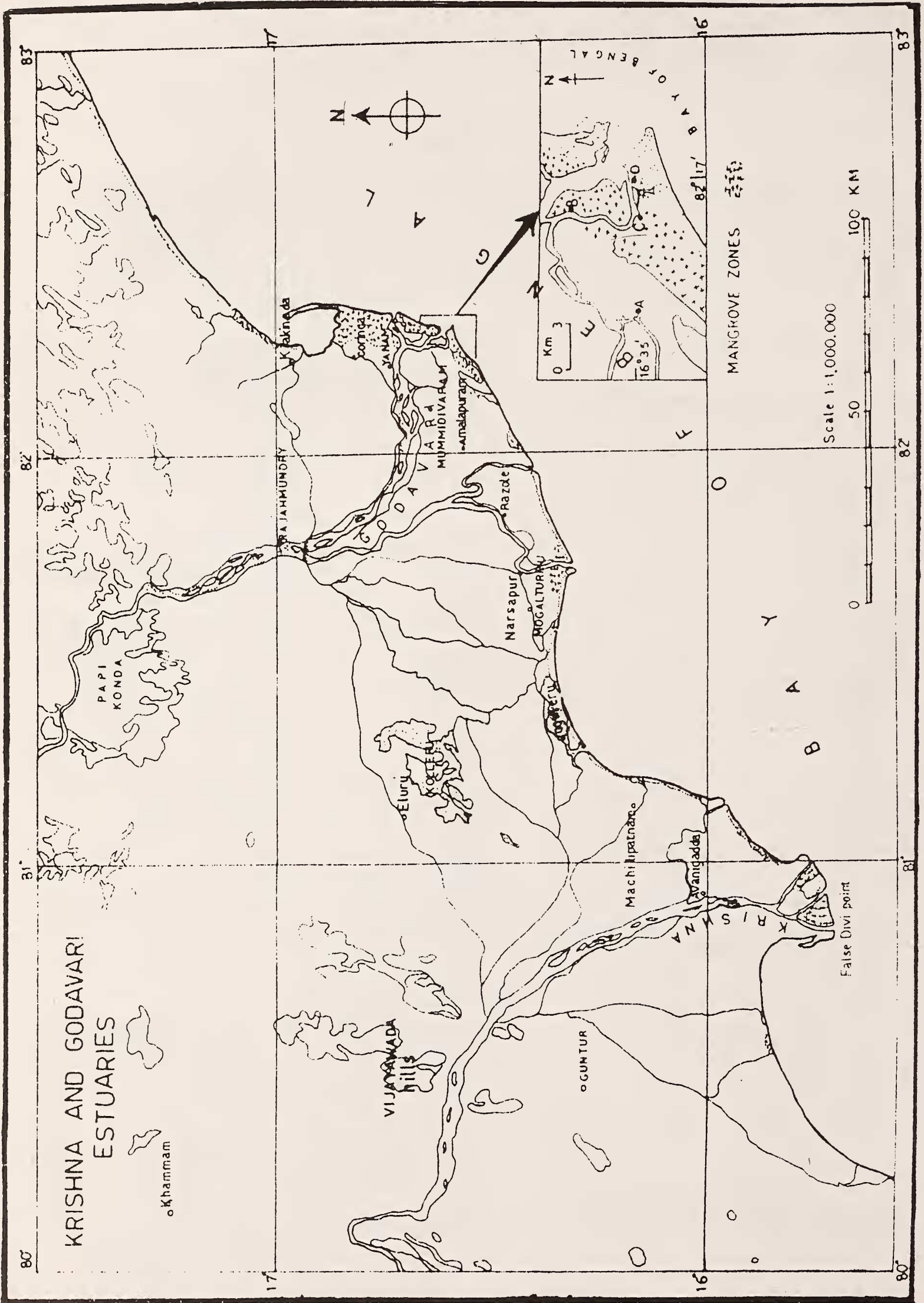


Fig. 1. Distribution of mangroves in Krishna and Godavari estuaries
 Inset: present locality of *Scyphiphora hydrophyllacea*, A. Kandikuppa; B. Balusuthippa; C. Kothapalem; D. Sacramento light house.

TABLE 1
DETAILS OF AREA COVERED BY MANGROVE FORESTS*

Zone	Forest Area	Total Forest Area (sq. km)
Godavari Estuary:		
Coringa	Coringa	42.42
	Coringa extension	194.67
Balusutippa	Masanitippa	10.89
	Balusutippa	4.75
	Rathikalva	20.49
	Kothapalem	0.50
Pandi	Kandikuppa	38.02
	Matlatippa	4.45
Krishna Estuary:		
Yela chettu dibba palem	Yela chettu dibba palem	37.14
	Yela chettu dibba palem extension	6.10
Nachugunta	Nachugunta	60.65
	Nachugunta extension	8.76
Sorlagondi	Sorlagondi	25.09
	Sorlagondi extension	26.91
		480.84

*Data from Andhra Pradesh Forest Department.

count on the mangroves of these estuaries.

The present work gives data on composition besides enumeration of flora.

VEGETATION

The general pattern of the vegetation indicates a sort of zonal distribution among the species of the mangrove forests. The spiny *Acanthus ilicifolius* L., and the tall grass *Myriostachya wightiana* (Nees ex Steud.) Hk. f. often mixed with *Clerodendrum inerme* Gaertn. form dense thickets, lining the network of canals. These are followed by the pioneer species of the muddy flats, namely *Avicennia marina* (Forssk.) Vierh., *A. officinalis* L., which pave the way for the species of *Rhizophora*, *Bruguiera*, *Ceriops*, *Sonneratia* and a few others. *Avicennia* species form the main component of the vegetation, towards the land side with comparatively shallower

water usually covered by the species of *Lumnitzera*, *Aegiceras*, *Excoecaria* etc.

Near Coringa the network of canals is lined by *Acanthus*, *Myriostachya* and *Hibiscus tiliaceus* L., a Malvaceous shrub, *Impomoea violacea* L., *Caesalpinia nuga* Ait., *Derris trifoliata* Lour., etc. are found, except this locality nowhere in India *Hibiscus tiliaceus* L. is an element with mangroves.

Similar to the Bengal coast the three species of *Avicennia* have been recorded. Finally the much exposed regions are occupied by the halophytic species like *Suaeda*, *Salicornia*, *Arthrocnemum*, *Cressa*, *Heliotropium*, *Aeluropus* etc.

Very interesting phytogeographical observations were made on these mangrove forests, at Nachugunta of Krishna estuaries. *Prosopis chilensis* (Molina) Stuntz and *Mimosa polyancistra* Benth. grow in association with *Sonneratia apetala* Buch.-Ham. and *Myriostachya wightiana* (Nees ex Steud.) Hk. f. in the islands which are nearer to the sea. *Suaeda monoica* Forssk. ex Gmel. grows unusually tall, nearly 1-2 m. at Yela chettu dibba palem towards inland. Pure stands of *Rhizophora apiculata* Bl. were also observed along the Krishna river bank at Yela chettu dibba palem. Banks of Krishna river at Nagayalanka-Yela chettu dibba palem were fully covered with *Acacia nilotica* (L.) Wild. ex Del. spp. *indica* (Benth.) Brenan. Near Coringa of the

TABLE 2
BRIEF ANALYSIS OF ESTUARINE FLORA UNDER DIFFERENT GROUPS

Group	Family	Genera	Species
True mangroves	8	10	15
Mangrove associates	13	18	18
Halophytes	6	8	10
Sea grasses	1	1	2
Total	26	37	45

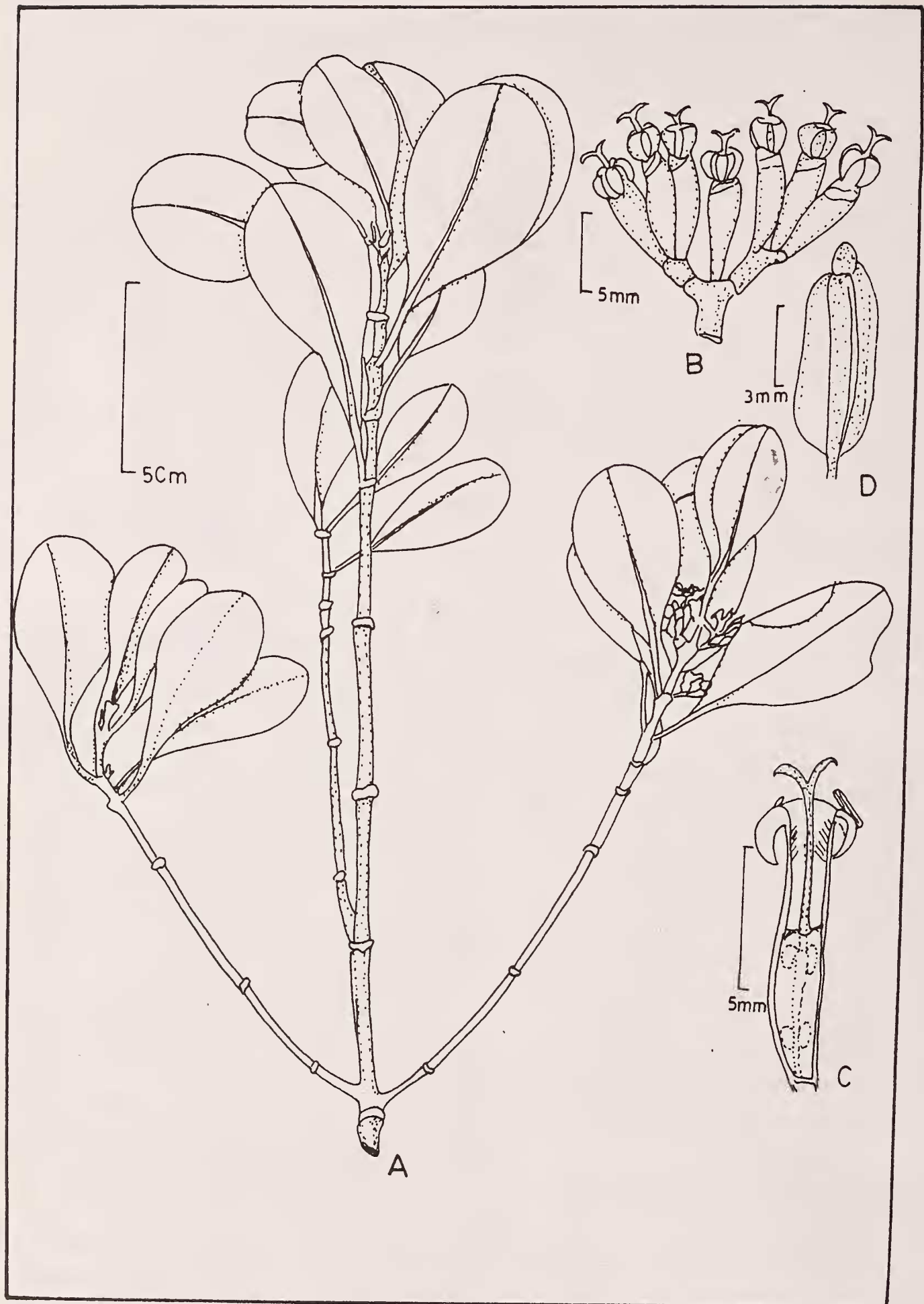


Fig. 2. *Scyphiphora hydrophyllacea*
A. Twig; B. Inflorescence; C. Flower L.S.; D. Fruit.

TABLE 3
THE DISTRIBUTION OF THE SPECIES IN DIFFERENT GROUPS

Species	Estuary	
	Godavari	Krishna
True mangroves		
<i>Aegialitis rotundifolia</i> Roxb.	-	+
<i>Aegiceras corniculatum</i> (L.) Bl.	+	+
<i>Avicennia alba</i> Bl.	+	+
<i>Avicennia marina</i> (Forssk.) Vierh.	+	+
<i>Avicennia officinalis</i> L.	+	+
<i>Bruguiera cylindrica</i> (L.) Bl.	-	+
<i>Bruguiera gymnorrhiza</i> (L.) Lam.	+	+
<i>Ceriops decandra</i> (Griff.) Ding Hou	+	+
<i>Lumnitzera racemosa</i> Willd.	+	+
<i>Rhizophora apiculata</i> Bl.	+	+
<i>Rhizophora mucronata</i> Lam.	-	+
<i>Scyphiphora hydrophyllacea</i> Gaertn. f.	+	-
<i>Sonneratia apetala</i> Buch.-Ham.	+	+
<i>Sonneratia caseolaris</i> (L.) Engl.	+	-
<i>Xylocarpus granatum</i> Koen.	+	+
Mangrove associates:		
<i>Acanthus ilicifolius</i> L.	+	+
<i>Barringtonia acutangula</i> (L.) Gaertn.	+	-
<i>Caesalpinia nuga</i> Ait.	+	+
<i>Clerodendrum inerme</i> Gaertn.	+	+
<i>Dalbergia horrida</i> (Dennst.) Mabb.	+	+
<i>Derris trifoliata</i> Lour.	+	+
<i>Excoecaria agallocha</i> L.	+	+
<i>Hibiscus tiliaceus</i> L.	+	-
<i>Ipomoea violacea</i> L.	+	-
<i>Mimosa polyancistra</i> Benth.	-	+
<i>Myriostachya wightiana</i> (Nees ex Steud.) Hk.f.	+	+
<i>Prosopis chilensis</i> (Molina) Stuntz	-	+
<i>Proterasia coarctata</i> (Roxb.) Takeoka	+	-
<i>Salvadora persica</i> L.	-	+
<i>Sarclobus carinatus</i> Wall.	+	+
<i>Stictocardia tiliifolia</i> (Desr.) Hall.f.	+	-
<i>Tamarix troupii</i> Hole	+	+
<i>Thespesia populnea</i> Cav.	+	-
Halophytes:		
<i>Aeluropus lagopoides</i> (L.) Trin.	+	+
<i>Arthrocnemum indicum</i> (Willd.) Moq.	+	+
<i>Cressa cretica</i> L.	+	+
<i>Fimbristylis cymosa</i> R. Br.	+	+
<i>Heliotropium curassavicum</i> L.	+	+
<i>Salicornia brachiata</i> Roxb.	+	+
<i>Sesuvium portulacastrum</i> L.	+	+
<i>Suaeda maritima</i> (L.) Dummort	+	+
<i>Suaeda monoica</i> Forssk.	+	+
<i>Suaeda nudiflora</i> Moq.	-	+
Sea grasses:		
<i>Halophila beccarii</i> Asch.	+	+
<i>Halophila ovalis</i> (R. Br.) Hk.f.	+	+

+ presence - absence of the species

Godavari estuary *Barringtonia acutangula* (L.) Gaertn. lines the creeks in association with *Avicennia marina* (Forssk.) Vierh. and *A. officinalis* L.

In raised sandy areas near the sea coast where tree species of mangrove do not flourish well, plantations of *Casuarina equisetifolia* Forst. & Forst. f. and *Eucalyptus* species have been very successfully reared. Along the muddy flats, sea grasses like *Halophila ovalis* (R. Br.) Hk. f. and *H. beccarii* Asch. have been recorded from both the estuaries.

Scyphiphora hydrophyllacea Gaertn. f. (Rubiaceae) (Fig. 2), which is rare on the Indian mainland, has been recorded for the first time along the creeks near Sacramento light house of Godavari estuary. This monotypic species is associated mostly with *Lumnitzera*, *Ceriops* and *Aegiceras*.

In the following enumeration, the species are arranged alphabetically, the botanical name followed by family, vernacular name, locality with field number (collected by author) and notes. The specimens have been deposited at the Andhra University Botany Department Herbarium (AUH) (yet to be placed in Index Herbarium), Waltair. Floristic analysis (Table 2) and species in each group (Table 3) are also recorded. Abbreviation used in the text is) R.F.=Reserve Forests.

SPECIES ENUMERATION

Acanthus ilicifolius L. Acanthaceae. Alchi. Sacramento light house, Kandikuppa R.F., 1599; Bandar Fort R.F., 5070 and 5353; China gollapalem, 1577 and 5109. Common along marshy creeks.

Aegialitis rotundifolia Roxb. Plumbaginaceae. Yeti putcha. Observed at Nachugunta R.F. associated with *Lumnitzera*, *Aegiceras* etc.

Aegiceras corniculatum (L.) Blanco Myrsinaceae. Guggilam. Kothapalem, 3, Sacramento light house, 1596; Nachugunta R.F., 5078; Bandar Fort R.F., 5066 and 5354; China gollapalem, 1578 and 5107. Common, close to the backwater edges.

Aeluropus lagopoides (L.) Trin. ex Thw. Poaceae. Puvvu gaddi. Masanitippa, 29; Bandar Fort R.F., 5059. Common along open saline beds.

Arthrocnemum indicum (Willd.) Moq. Chenopodiaceae. Ela kura. Masanitippa, 27; Nachugunta R.F., 5072; Bandar Fort R.F., 5061; China gollapalem, 5768. Frequent along open saline beds.

Avicennia alba Bl. Avicenniaceae. Vilava mada. Sacramento light house, 1591; China gollapalem, 1579; Yela chettu dibba palem R.F., 5614. Found very few populations, associated with *Sonneratia* and *Rhizophora* spp.

Avicennia marina (Forssk.) Vierh. Avicenniaceae. Tella mada. Sacramento light house, 7; Turputalla, 48; Yela chettu dibba palem R.F., 5079 and 5765; Bandar Fort R.F., 5355 and 5356. Very common along the backwaters.

Avicennia officinalis L. Avicenniaceae. Nalla mada. Sacramento light house, 1590; Yela chettu dibba palem R.F., 5612; China gollapalem, 5102. Very common along the backwater creeks of Godavari estuary and rare along the Krishna estuary.

Barringtonia acutangula (L.) Gaertn. Barringtoniaceae. Tarepu. Frequently observed along the inner creeks of Coringa and Matlapalem areas of Godavari estuary.

Bruguiera cylindrica (L.) Bl. Rhizophoraceae. Vurudu. Yela chettu dibba palem R.F., 5607. Found only along the Krishna estuary.

Bruguiera gymnorrhiza (L.) Savi. Rhizophoraceae. Thuddu ponna. Sacramento light house, 11; Kothapalem, 1581; Yela chettu dibba palem R.F., 5606. Common along the creeks with well formed knee-roots.

Caesalpinia nuga Ait. Caesalpinaceae. Mulla theega. Yela chettu dibba palem R.F., 5608. Also observed at Coringa.

Ceriops decandra (Griff.). Ding Hou Rhizophoraceae. Gatheru. Kothapalem, 2; Masanitippa, 25; China gollapalem, 1582; Sacramento light house, 1592; Yela chettu dibba palem R.F., 5610. Found close to the backwater canals, just behind the *Rhizophora* belt.

Clerodendrum inerme (L.) Gaertn. Verbenaceae. Eti pisiniki. Kothapalem, 10; Perupalem, 1584; Yela chettu dibba palem R.F., 5603; Nachugunta R.F., 5075; Bandar Fort R.F., 5067. Common along the creeks.

Cressa cretica L. Convolvulaceae. Uppu mokka. Balusuthippa, 56; Nachugunta R.F., 5074. Common in open saline beds.

Dalbergia horrida (Dennst.) Mabb. Fabaceae. Chillangi. Masanitippa, 32; Yela chettu dibba palem R.F., 5604; Bandar Fort R.F., 5132 and 5366; China gollapalem, 5106. Common spiny shrub in the interior component of mangrove scrub.

Derris trifoliata Lour. Fabaceae. Nalla theega. Masanitippa, 30; Yela chettu dibba palem R.F., 5605; China gollapalem, 1576 and 5101. Common twiner, found along the inner regions.

Excoecaria agallocha L. Euphorbiaceae. Thilla. Kothapalem, 1; Perupalem, 1587; Sacramento light house, 1600; Yela chettu dibba palem R.F., 5601; Nachugunta R.F., 5077; Bandar Fort R.F., 5069. Most common in these estuaries.

Fimbristylis cymosa R. Br. Cyperaceae. Commonly observed in the marshy creeks along with Proteraceae.

Halophila beccarii Asch. Hydrocharitaceae. Yela chettu dibba palem R.F., 6118 and also observed along the Pandi creek. Rare in the muddy coast in mangrove zones. The present report extends its distribution from south to the north along the east coast.

Halophila ovalis (R.Br.) Hk.f. Hydrocharitaceae. Yela chettu dibba palem R.F., 6117 and also observed along the pandi creek. Abundant in muddy flats in mangrove zones.

Heliotropium curassavicum L. Boraginaceae. Nela golividi. Etimoga 5081. Common in open saline beds.

Hibiscus tiliaceus L. Malvaceae. Konda prathi. Very common along the creeks near Coringa.

Ipomoea violacea L. Convolvulaceae. Gaju theega. Matlapalem, 6317. Very abundant along the thickets near Coringa and its surrounding regions.

Lumnitzera racemosa Willd. Combretaceae. Thanduga. Masanitippa, 1597; China gollapalem, 1583; Yela chettu dibba palem R.F., 5616; Bandar Fort R.F., 5068 and 5133. Commonly associated with *Ceriops* and *Aegiceras*.

Mimosa polyancistra Benth. Mimosaceae. Pichu regu. Nachugunta R.F., 5557. Associated with *Aegialitis*. The first report of this species in the estuaries.

Myriostachya wightiana (Nees ex Steud.) Hk.f. Poaceae. Ela Kara, Kikkisa. Perupalem, 1586; Yela chettu dibba palem, 5609; China gollapalem, 5110. Common along the edges of the creeks.

Prosopis chilensis (Molina) Stuntz Mimosaceae. Mulla thumma. Nachugunta R.F., 5445. Gregariously growing along the estuaries associated with *Sonneratia* spp. This report confirms its occurrence at Krishna estuary along with mangroves (Rao 1959).

Proterasia coarctata (Roxb.) Takeoka. Poaceae. Kothapalem, 14. Very rare grass observed along with *Fimbristylis cymosa* at Coringa.

Rhizophora apiculata Bl. Rhizophoraceae. Kaki ponna. Sacramento light house, 12; Kothapalem, 1595; Yela chettu dibba palem R.F., 5112; Perupalem, 5770. Buttressed by long stilt roots (knee roots) forming the outermost fringe of the mangrove vegetation towards the sea. The plant remains on the stilt roots after the main stem dies.

The author observed at Perupalem (l.c.) an old, large single tree with huge stilt roots. The bark of these roots was being eaten by goats, though it contains a large amount of tanins.

Rhizophora mucronata Poir. Rhizophoraceae. Uppu ponna. Yela chettu dibba palem R.F., 5602. Rare. Associated with *R. apiculata*; stilt roots rather vertical; spread of crown less than that of *R. apiculata*. Only observed along the Krishna estuary.

Salicornia brachiata Roxb. Chenopodiaceae. Sitamma vari dubbu. Perupalem, 1585. Found extensively along the open saline beds.

Salvadora persica L. Salvadoraceae. Pedavara gogu. Yela chettu dibba palem village, 5763. A typical plant of saline soils along the coast or in backwaters above mangrove forests.

Sarclobus carinatus Wall. Asclepiadaceae. Pala boddu theega. Kothapalem, 5; China gollapalem, 1575; Yela chettu dibba palem R.F., 5611. Common twiner on *Dalbergia* and *Clerodendrum*.

Scyphiphora hydrophyllacea Gaertn. f. Rubiaceae (Fig. 2). Nara thanduga. Sacramento light house (the area presently preserved by A.P. Forest Dept. Fig. 1 inset D), 51 and 1598. This is the first report of this taxon from the Indian mainland. Rare in mainland abundant in Andaman islands. (Thothathri 1962).

Sesuvium portulacastrum (L.) L. Aizoaceae. Thikka kura, Adavi baddu. Masanitippa, 41; Sacramento light house, 52 and 1593; Yela chettu dibba palem R.F., 5613; Bandar Fort R.F., 5565. Commonly found along the muddy flats and the

banks of the creeks.

Sonneratia apetala Buch.-Ham. Sonneratiaceae. Pedda kalinga. Yela chettu dibba palem R.F., 5615; China gollapalem, 5108. The species grows in association with *Myriostachya* and *Prosopis chilensis*.

Sonneratia caseolaris (L.) Engl. Sonneratiaceae. China kalinga. Masanitippa, 31. Rarely found at Godavari estuary.

Stictocardia tiliifolia (Desr.) Hall. f. Convolvulaceae. Observed at Coringa. Straggler on mangrove thickets.

Suaeda maritima (L.) Dumont. Chenopodiaceae. Ela Kura. Kothapalem, 6; Sacramento light house, 1589, Yela chettu dibba palem, 5766; Nachugunta R.F., 5076; Bandar Fort R.F., 5062. Appears as pure stands along open saline beds.

Suaeda monoica Forssk. ex Gmel. Chenopodiaceae. Goliguru dubbu. Masanitippa, 26; Nachugunta R.F., 5071. Pure stands reaching nearly 1-2 m are seen in Yela chettu dibba palem R.F., towards the land.

Suaeda nudiflora Moq. Chenopodiaceae. Jilugu. Yela chettu dibba palem R.F., 5617. Rare in comparison with the other 2 species.

Tamarix troupii Hole. Tamaricaceae. Palligi. Yela chettu dibba palem, 5767. Found in the Krishna river bed nearer to the sea and also at Matlapalem of the Godavari estuary.

Thespesia populnea (L.) Soland. ex Correa. Malvaceae. Ganga ravi. Kothapalem, 9. Found only at the Godavari estuary, very abundant at Coringa.

Xylocarpus granatum Koen. Meliaceae. Chenuga. Sacramento light house, 13; China gollapalem, 5769. Rare, a few individuals associated with *Avicennia* spp.

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